I claim:

1. A method for reducing required coherence time for a quantum computation, comprising:

constructing a first series of operations on qubits that perform the quantum computation; and

constructing a second series of operations from the first series by changing an execution order of the commuting operations to reduce the time required for a quantum computing device to complete the second series of operations.

2. The method of claim 1, wherein constructing the second series of operations from the first series of operations comprises changing the execution order of the commuting operations in the first series so that two or more operations are performed simultaneously in the second series.

3. The method of claim 2, wherein the first series of operations includes a swap operation that changes a first qubit and a second qubit from having respectively a first state and a second state to having respectively the second state and the first state.

4. The method of claim 3, wherein:

changing the order of the commuting operations eliminates a need for the swap operation; and

constructing the second series further comprises omitting the swap operation from the second series so that execution of the second series of operations performs the quantum calculation faster than executing the first series of operation.

5. The method of claim 1, wherein

the first series of operations includes a swap operation that changes a first qubit and a second qubit from having respectively a first state and a second state to having respectively the second state and the first state; and

changing the order of the commuting operations in the first series eliminates a need for the swap operation; and

constructing the second series of operations further comprises omitting the swap operation from the second series so that execution of the second series of operations performs the quantum calculation faster than executing the first series of operation.

6. A method for performing a swap operation in a quantum computing device, the method comprising:

performing operations from a sequence of operations; and

simultaneously performing two of the operations that commute.

7. The method of claim 6, wherein performing the sequence of operations comprises:

simultaneously performing a first operation $Z_r(\pi/2)$ on a qubit r and a second operation $Z_s(\pi/2)$ on a qubit s;

sequentially performing third operation $X_s(\pi/2)$ on the qubit s, a fourth operation $Z_s(\pi/2)$ on the qubit s, and a fifth operation $CP_{rs}(\pi/2)$ on the qubits r and s;

simultaneously performing a sixth operation $X_s(\pi/2)$ on the qubit s and a seventh operation $X_r(\pi/2)$ on the qubit r;

sequentially performing eighth operation $Z_r(\pi/2)$ on the qubit r, and a ninth operation $CP_{rs}(\pi/2)$ on the qubits r and s;

simultaneously performing a tenth operation $X_r(\pi/2)$ on a qubit r and an eleventh operation $Z_s(\pi/2)$ on a qubit s;

sequentially performing twelfth operation $X_s(\pi/2)$ on the qubit s, a thirteenth operation $Z_s(\pi/2)$ on the qubit s, a fourteenth operation $CP_{rs}(\pi/2)$ on the qubits r and s, and a sixteenth operation $X_s(3\pi/2)$.

8. The method of claim 7, wherein the third, sixth, seventh, tenth, twelfth, and sixteenth operations act on the two states of the respective qubits according to the following equation

$$X(\theta) = e^{\frac{-i\sigma_x\theta}{2}}.$$

9. The method of claim 7, wherein the first, second, fourth, eighth, eleventh, and thirteenth operations act on the two states of the respective qubits according to the following equation

$$Z(\phi) = e^{\frac{-i\sigma_z\phi}{2}}.$$

10. The method of claim 6, wherein the fifth, ninth, and fourteenth operations act on the four combined states of the qubits r and s according to the following equation

$$CP(\varsigma) = e^{\frac{-i\sigma_z\otimes\sigma_z\varsigma}{2}}$$